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Clowers et al.

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[54] **PALM GRIP RANDOM ORBIT SANDER WITH LOWER HOUSING AND DUST COLLECTOR COUPLED TO LOWER HOUSING**

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[73] Assignee: **Porter Cable Corporation**, Jackson, Tenn.

[*] Notice: This patent is subject to a terminal disclaimer.

[21] Appl. No.: **08/954,452**

[22] Filed: **Oct. 20, 1997**

Related U.S. Application Data

[63] Continuation of application No. 08/613,147, Mar. 8, 1996, Pat. No. 5,791,977, which is a continuation of application No. 08/334,855, Nov. 4, 1994, Pat. No. 5,518,442, which is a continuation of application No. 08/009,309, Jan. 22, 1993, abandoned.

[51] **Int. Cl.**[6] **B24B 23/03**

[52] **U.S. Cl.** **451/357**; 451/359; 451/453; 451/456

[58] **Field of Search** 451/344, 353, 451/357, 359, 453, 456; 55/523

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[57] **ABSTRACT**

A pad sander skirt which flares out over the periphery of the sanding pad and which is coupled to a lower housing so that it swivels about the body of the sander. The skirt and lower housing can be selectively swivelled in a rotational manner to a position desired by the user. A further sander improvement disclosed relates to the protection of a user's hand. Palm-grip random orbit sanders are sometimes configured so that the sanding pad may begin spinning at high speed when the sander is lifted off of the work. To this end, the present application discloses a protective skirt which flares out over the periphery of the pad in a palm-grip random orbit sander. Also disclosed is an improved dust collection system comprising a filter housing formed of a rigid porous material for entrapping dust.

38 Claims, 6 Drawing Sheets

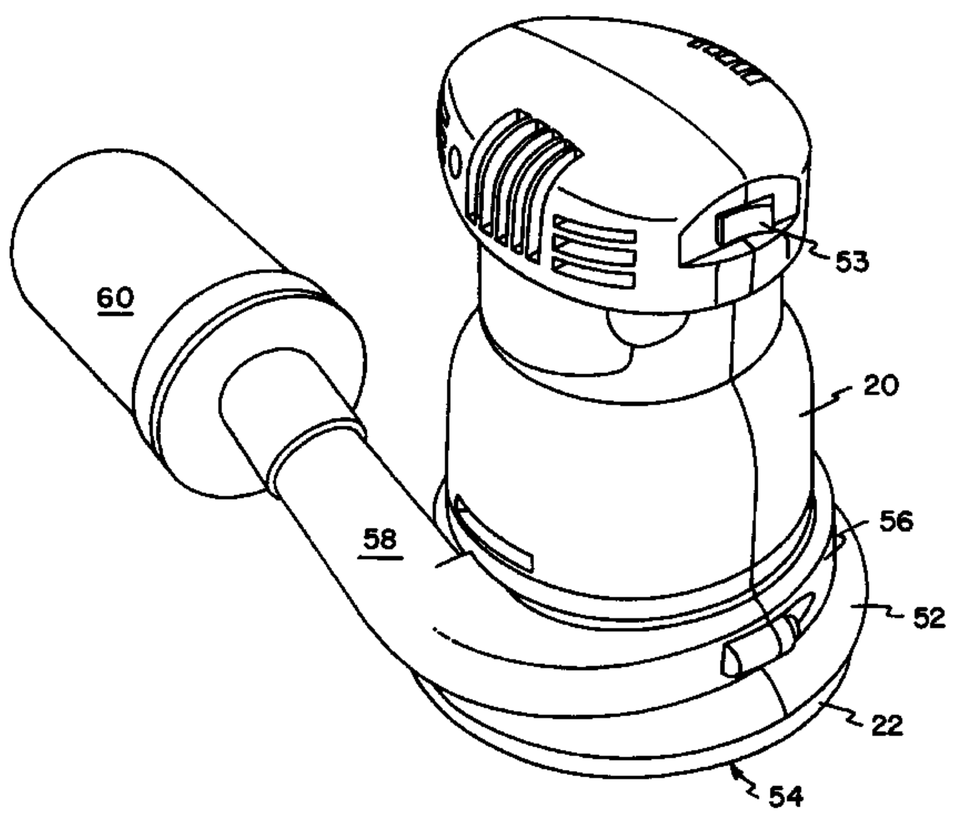

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FIG. 1

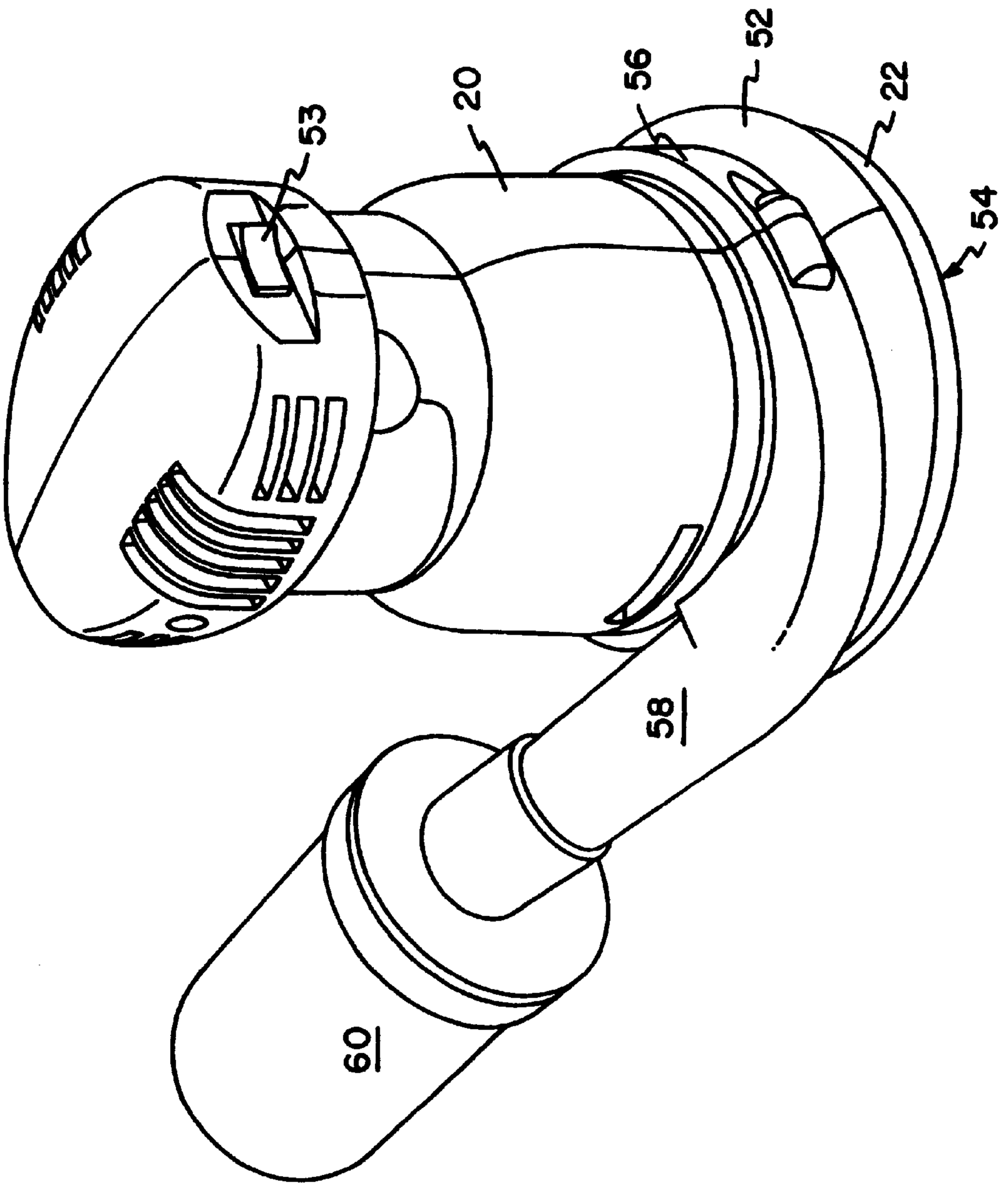
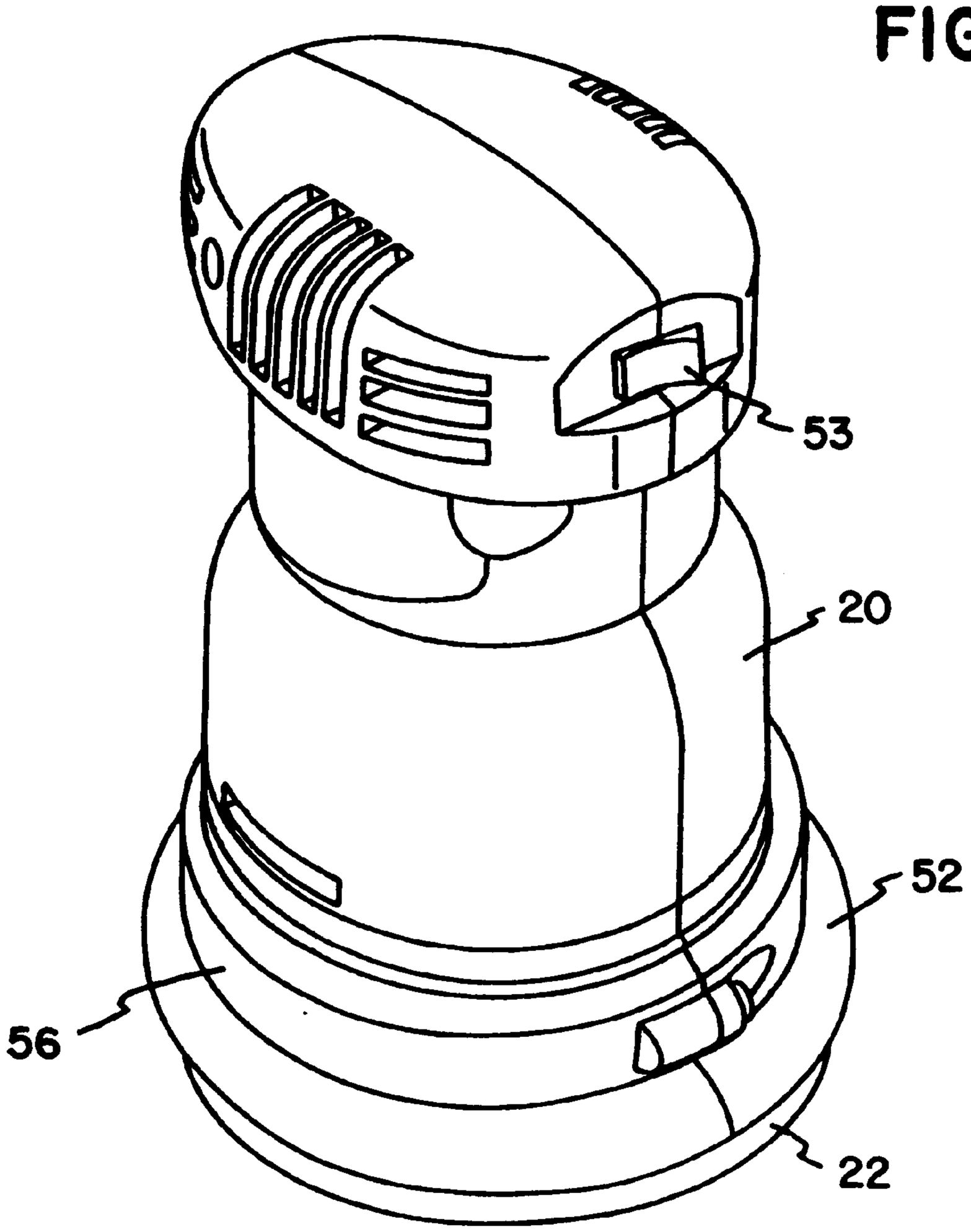


FIG. 1A



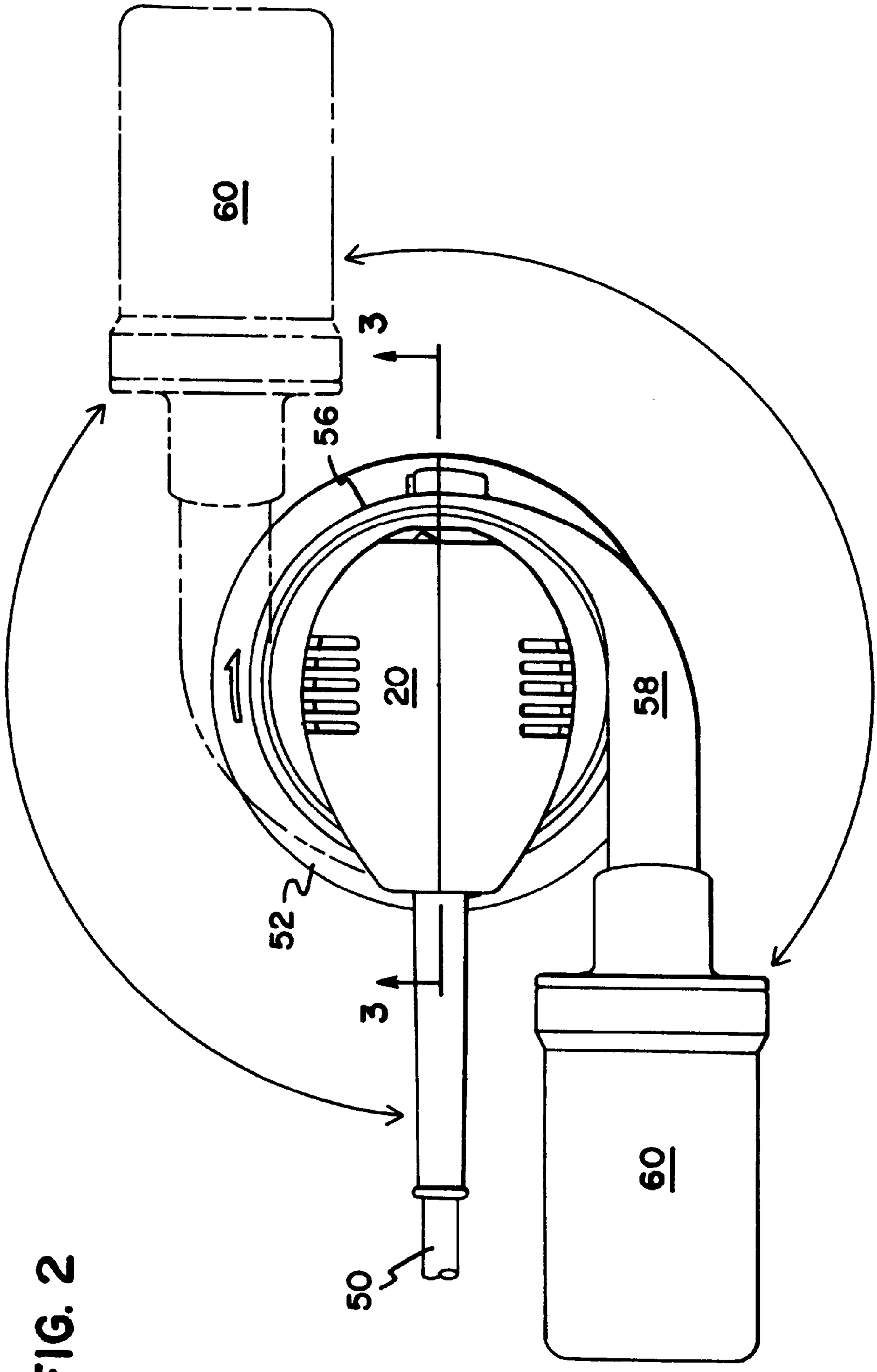


FIG. 2

FIG. 3

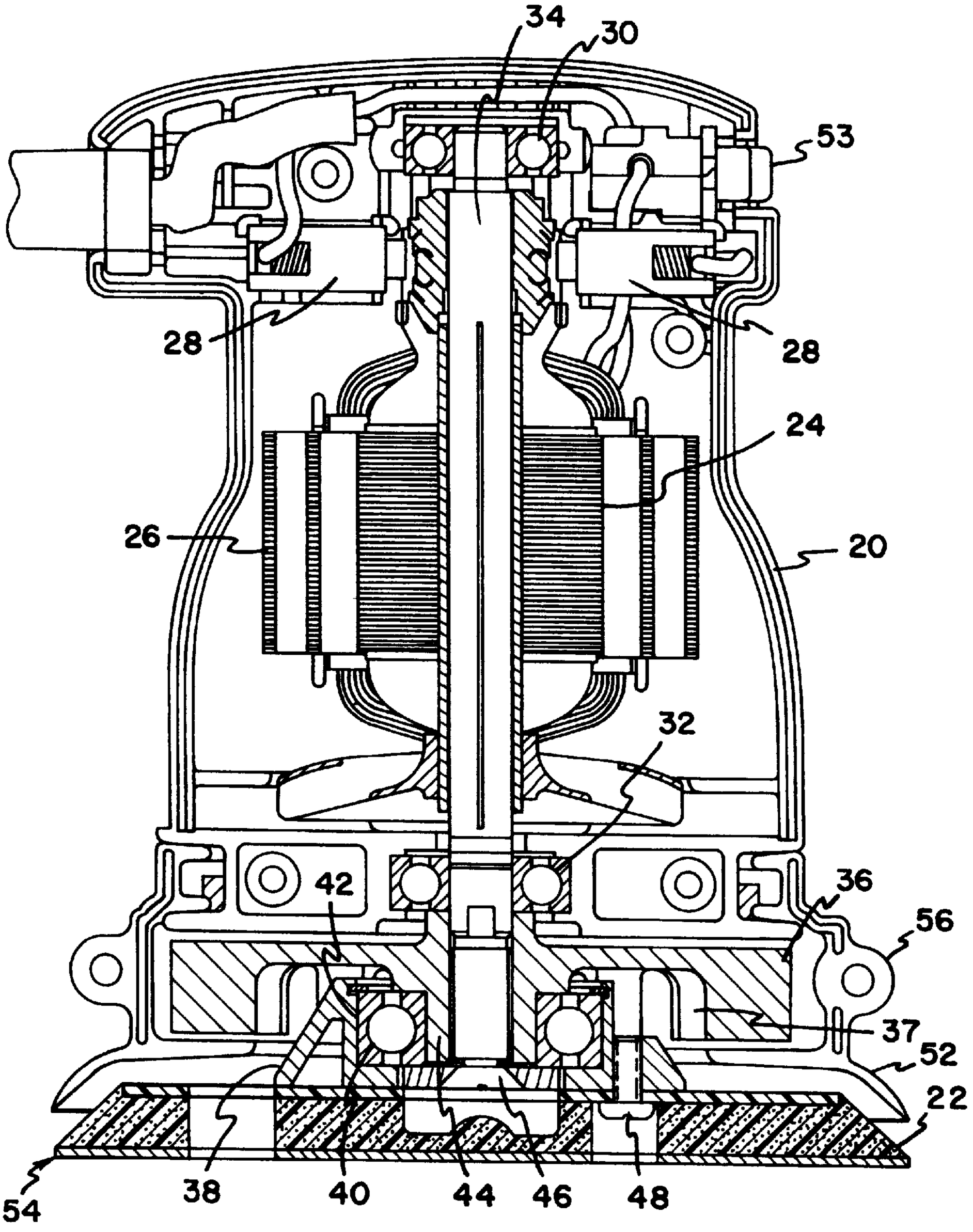


FIG. 4

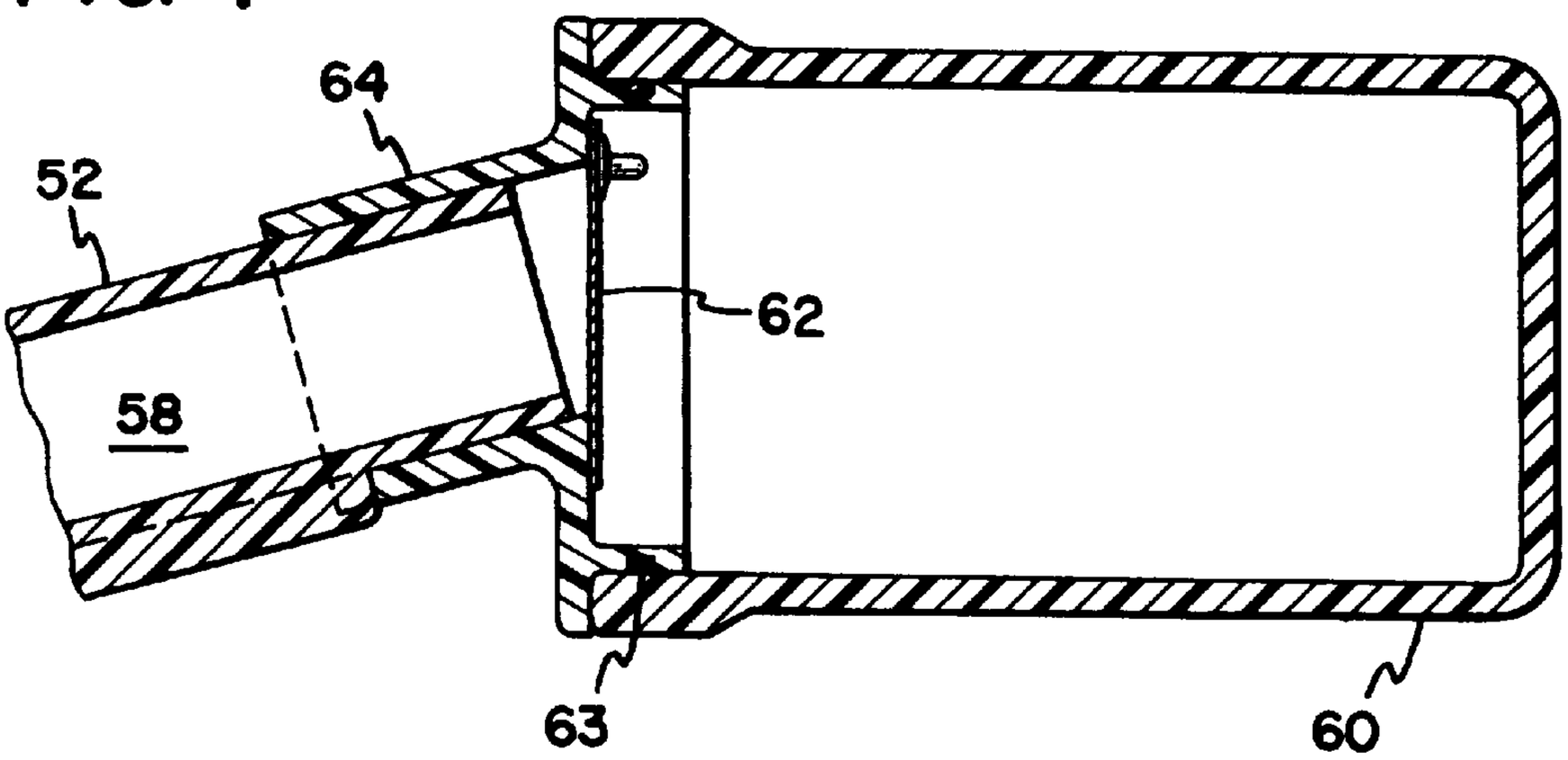


FIG. 5

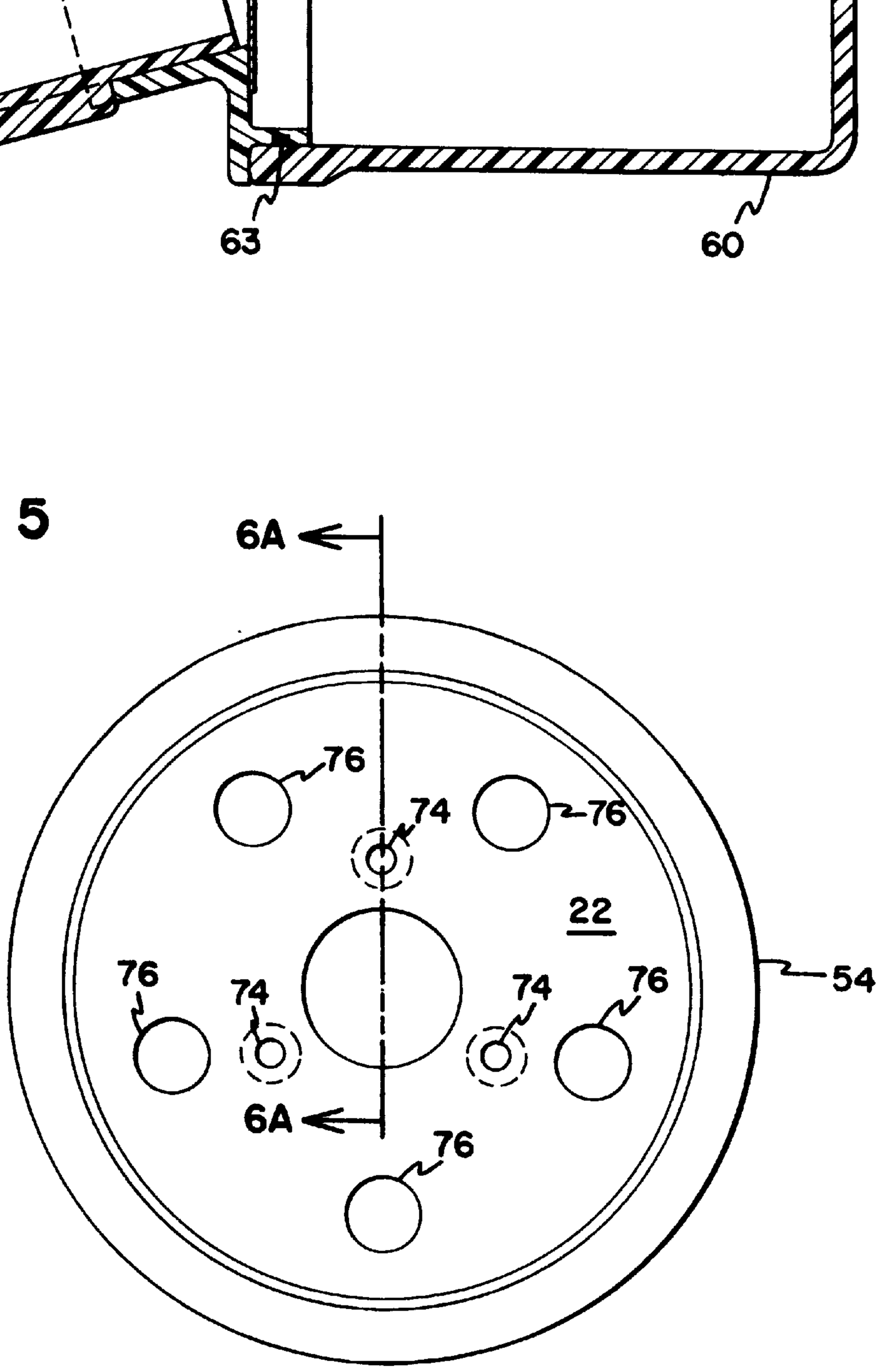


FIG. 6A

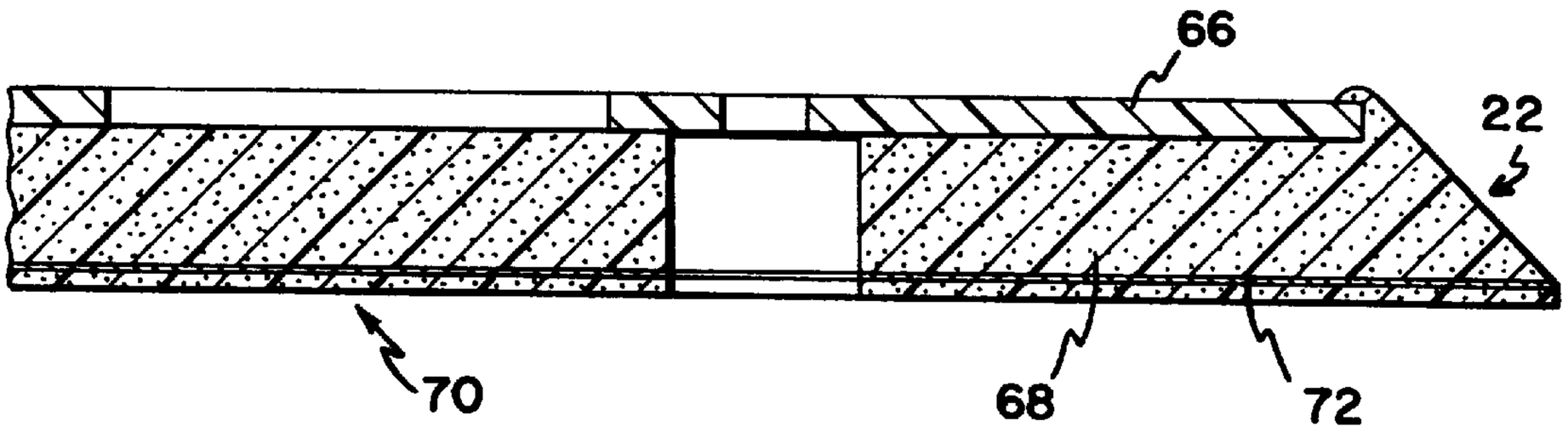
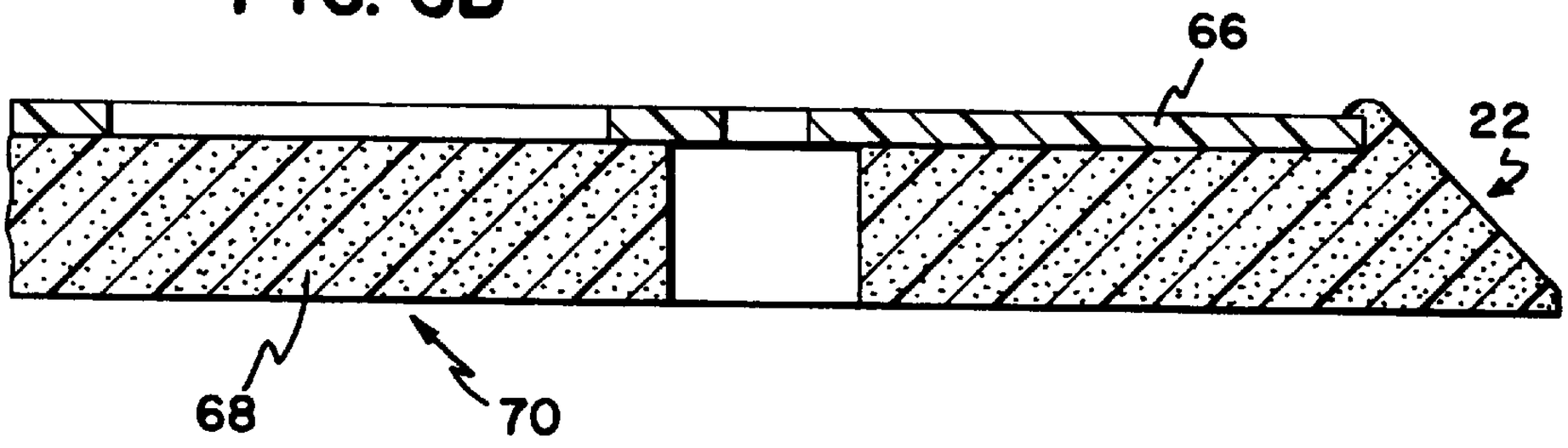


FIG. 6B



PALM GRIP RANDOM ORBIT SANDER WITH LOWER HOUSING AND DUST COLLECTOR COUPLED TO LOWER HOUSING

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 08/613,147, filed Mar. 8, 1996 now U.S. Pat. No. 5,791,977. Application Ser. No. 08/613,147 is a continuation of application Ser. No. 08/334,855, filed Nov. 4, 1994, now U.S. Pat. No. 5,518,442. Application Ser. No. 08/334,855 was a continuation of application Ser. No. 08/009,309, filed Jan. 22, 1993, now abandoned. Each of these applications is incorporated herein by reference.

BACKGROUND AND SUMMARY OF THE INVENTION

The present application is directed to sander improvements. These improvements include a pad sander lower housing having a skirt which flares out over the periphery of the sanding pad. The lower housing can be selectively swivelled in a rotational manner to a position desired by the user. This has particular advantages in dustless versions of a sander in which it may be desirable to reposition the dust collection system.

A further improvement relates to the protection of a user's hand. Palm-grip random orbit sanders sometimes are configured so that the sanding pad may begin spinning at high speed when the sander is lifted off of the work. Since palm-grip random orbit sanders can be grasped by a single hand in a manner that might put the user's fingers in contact with a high speed spinning pad, protection against injury is desirable. To this end, the present application discloses a protective skirt which flares out over the periphery of the pad in a palm-grip random orbit sander. The skirt may be configured for either dustless versions of such sanders, in which case the skirt typically also forms a portion of the dust collection system, as well as with dusty versions of the sander, in which case the primary purpose of the skirt is to prevent contact of the user's hand and fingers with the pad.

In sanders with dust collectors, particularly those that use passive systems such as a cloth bag to catch dust, the dust collection apparatus can be both relatively cumbersome and ineffective. In an improvement to such passive systems, the present application discloses a sander dust collector filter housing formed of a rigid, porous material for entrapping dust. Such a dust collection system can be made in a compact manner which is particularly suitable for palm-grip sanders, whether the sander be of an orbital, dual action, or random orbit type. Larger versions of such filter housings may be used with larger sanders.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a sander which incorporates a dust collection system.

FIG. **1A** illustrates a similar sander without a dust collection system.

FIG. **2** is a top view of a sander showing a dust collection system which can be rotationally oriented in a direction selected by the user.

FIG. **3** shows a cross-sectional view of a sander.

FIG. **4** illustrates a dust collection housing.

FIG. **5** illustrates a top plan view of a sanding pad which incorporates dust collection holes.

FIG. **6A** and **6B** illustrate alternative embodiments of a sander back-up pad.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** illustrates a sander having a body or housing **20** which is typically comprised of two halves secured together by conventional means and a pad **22** for holding sandpaper or other abrasives or materials (e.g., polishing pads) desired by the user. Such pads **22** can be configured in the pressure sensitive adhesive (PSA) variety as well as a hook and loop variety, each of which are familiar to those skilled in the art, and can be either with or without holes to incorporate either a sander with dust collection capability (for example, as shown in FIG. **1**) or without such capability (for example, as shown in FIG. **1A**). Pad **22** has an outer periphery substantially defining the size of sandpaper or other material supported by the pad.

The sander shown in FIGS. **1** and **1A** have a body or housing **20** sized for a palm grip at the top of the housing and for a single-handed grip around the body. A motor housed by body **20** typically comprises an armature **24**, a field **26**, and brush and spring assemblies **28**. Upper and lower ball bearings **30** and **32** are supported by the housing and provide stability and smooth operation for motor shaft **34**. For a random orbit sander of the type shown, motor shaft **34** is typically directly coupled to a counterweight **36**, which may incorporate integral fan blades **37** used for dust collection.

In the embodiment shown, pad support **38** is coupled to counterweight **36** by a ball bearing **40** having its outer race diameter press fit into a cylindrical cavity **42** defined by pad support **38** and the inner diameter of its race slip fit onto an eccentrically-located cylindrical protrusion **44** of counterweight **36**. The connection between counter-weight **36** and pad support **38** imparts an orbital motion to the pad support **38**. Pad support **38** is shown further secured to armature shaft **34** by a machine screw **46**, which ensures a secure assembly of the counterweight **36**, bearing **40** and pad support **38**. Pad **22** is typically secured to pad support **38** by threaded machine screws **48**.

As has previously been indicated, the sander motor in the embodiment shown is powered electrically and for this purpose includes a power cord **50** with power being controlled by an on/off switch **53**. Those skilled in the art will recognize many other components illustrated in the cross-section of FIG. **3** as being typical to the assembly of an electrically-driven sander of a random orbit nature. Those skilled in the art will also recognize that suitable components of the sander shown could be replaced with well-known components if a sander of the orbital or dual-action variety is desired. Furthermore, in embodiments driven by an air motor, power cord **50** would be replaced by an air hose, and the components previously described which relate an electric motor would be replaced with suitable air motor components. Motors used in the preferred embodiments have a typical no-load speed of 12,000 RPM.

For the preferred random orbit sanders shown in the present application, when a sander is not in contact with the work, the rotational restraint established between the inner race, balls, seals, grease, and the outer race of the bering **40** causes the pad assembly to spin at the same speed as the motor shaft. When the abrasive or other material mounted to pad **22** contacts the work, another rotational restraint is created which opposes the bearing restraint. This additional restraint varies with pressure, abrasive grade, etc. Through this process, the rotational speed of pad **22** (i.e., of the outer

race of bearing **40**) is reduced to approximately 300 RPM, while the orbital motion (inner race of bearing **40**) continues at a higher speed (12,000 OPM). In this manner, since the rotational speed of the pad is not synchronized with the orbital motion of the pad, the abrasive particles are made to travel in a "random orbital motion."

The sanders shown in the present application comprise a skirt **52** which flares out over the periphery **54** of pad **22**. As with housing **20**, skirt **52** is preferably formed of a rigid material (for example, polyamide) and is spaced slightly upward from pad **22**, giving pad **22** sufficient clearance from skirt **52** so that the sander can operate properly and so that dust can be pulled up between the periphery of pad **22** and skirt **52** by fan blades **37**. As previously indicated, fan blades **37** may be integrally formed in a central open region interior to counterweight **36**.

In the preferred embodiment, skirt **52** is formed integrally with a lower housing **56**, which is configured so that it can be selectively rotated about sander body **20** for enabling the lower housing to be oriented in a position desired by the user. The position selected by the user is typically maintained by friction between the exterior lower portion of the sander body **20** and the interior portion of lower housing **56**, each of which have complementary shapes to ensure retention of the lower housing on the sander body while enabling rotational adjustment. The ability to adjustably position lower housing **56** is particularly advantageous when lower housing **56** comprises a dust collection system defining a dust exhaust channel such as **58**. Such a dust exhaust channel may be coupled either to a passive dust collector such as a bag or filter housing **60** or by a hose to an active system such as a vacuum cleaner. In these scenarios, users may wish to adjust the position of the collection system with respect to sander or workpiece features.

As with body **20**, lower housing **56** may comprise two halves secured together by conventional means. For the version of the sander disclosed which incorporates dust collection, dust collection channel **58** is defined in part by a portion of lower housing **56**. FIG. **2**, which is a top plan view of the preferred sander embodiment comprising a passive dust collection system, illustrates how lower housing **56** may be selectively swivelled in a rotational manner to a position desired by the user. As can be seen, such positioning will enable the user to orient the direction of exhaust port **58** in a preferred direction relative to, for example, power cord **50**.

The preferred dust collection system is shown cross-sectionally in FIG. **4**. Note that the preferred system incorporates a membrane **62** which maintains a normally closed position in order to prevent the back flow of dust collected within filter **60** while enabling dust to enter the filter. Membrane **62** may be formed of polyester film having a nominal thickness of 0.007 inch. Filter housing **60** is typically coupled via friction fit to an adapter **64**, which in turn fits fictionally over dust exhaust channel **58** of housing **52** in order to removably interconnect the filter and adapter assembly with the sander exhaust port. O-ring **63** retained in place by a detent in adapter **64** helps maintain a good friction fit and seal for enabling long-life and easy removal of housing **60** from adapter **64**. When filter housing **60** is full of dust, it can be removed from adapter **64** and emptied by simply twisting housing **60** off of adapter **64** and tapping the filter housing briefly in order to empty it of dust. Note that, during this emptying procedure, membrane **62** preferably remains with adapter **64** and does not interface with emptying filter housing **60**.

In the preferred embodiment, filter housing **60** is formed by molding, sinterring or by other means a rigid, porous, plastic material, preferably porous polyethylene, polypropylene, polystyrene, or other polyolefins having a pore size effective to retain sanding dust; it has been found that a pore size of 120–140 microns is satisfactory. In the embodiment shown, filter housing **60** is substantially cylindrical and has an internal diameter of approximately two inches, a length of approximately four inches, and a typical wall thickness of 0.15 inch. Those skilled in the art will recognize that other sizes and shapes of sander filters consistent with the present filter invention may also be useful.

In the sander embodiments shown, pads **22** are typically five inches in diameter and comprise an upper member **66** of fiberglass-reinforced epoxy molded into a lower member **68**, which may be formed of integral skin-cast polyurethane. As is familiar to those skilled in the art, for pads used with PSA, a vinyl sheet is typically applied to the lower surface **70** of lower pad member **68**. This vinyl material is normally coated such that PSA sandpaper or the like will stick to the surface and yet, when the paper is removed, little or not abrasive will be present on the vinyl sheet. Pads **22** are typically rated for 13,000 RPM. PSA pads with lower surface **70** formed of vinyl or similar material may include an embossed grain applied in a mold (a surface familiar to those skilled in the art used with pressure-sensitive adhesive for adhering materials such as abrasive sheets to the pad). Alternatively, lower surface **70** may be formed of short-stemmed hook and loop material applied in the mold (a surface likewise familiar to those skilled in the art for use in connection with abrasive sheets or the like backed with hook and loop material).

In prior-art sander configurations operating in the random orbit mode, pad **22** is typically free of rotational restraint such that pad **22** may achieve a very high RPM when the motor is running and the sander is lifted off of the work. In such situations, if lower member **68** of pad **22** is formed of typical prior-art materials such as cast polyurethane foam, the pad may expand radially outward. Radial pad expansion in this manner can cause a sanding sheet adhered to the bottom face **70** of the pad to be released when PSA is used to bond the abrasive sheet to the pad. This release of the adhesive sheet has been found to be caused by the differential movement in the interface between bottom surface **70** of the pad and the adjoining layer of the adhesive sheet, resulting in release by the PSA of the sanding sheet. Such released abrasive sheets can be inconvenient to the user.

Accordingly, it has been found that use of an anti-radial-expansion mechanism coupled proximate the lower surface **70** of sanding pad member **68** can substantially prevent radial expansion of the pad and substantially eliminate the problem of PSA bonding failures between the pad and the adhesive sheet. In one preferred embodiment, the anti-radial-expansion system is achieved by molding a layer **72** of vinyl-coated fiberglass insect screening into the lower portion of pad member **68**. Such insect screening may have a mesh of 18 by 16 strands per inch with a strand diameter of 0.011 inch. Other similar fiberglass screening or materials may also be used in order to prevent the previously described radial expansion problem. An alternative is use of a square-weaved cloth backing molded into the vinyl coating at the bottom of the pad.

Pads **22** are typically secured to pad support **38** by machine screws **48** passed through mounting holes **74** formed in upper fiberglass member **66**. In sanding pads which comprise vacuum holes **76**, the vacuum holes are preferably molded in and not machined.

At the time of filing the present application, preferred embodiments of the sanders disclosed can be obtained from

Porter-Cable Corporation, the assignee of the present application, in three models. A model **332** does not incorporate dust collection and includes a PSA pad. A model **333** includes a dust collection system as well as a hook and loop pad. A model **334** is similar to the model **333** except that it incorporates a PSA pad.

The present invention is to be limited only in accordance with the scope of the appended claims, since persons skilled in the art may devise other embodiments still within the limits of the claims.

What is claimed is:

1. A palm grip random orbit sander comprising:

a sander body, a pad for supporting sandpaper, a motor housed by the sander body, and a random orbit coupler system which couples the motor to the pad to impart a random orbit sanding motion to the pad, the sander body being sized for a palm grip on a top of the sander body;

a lower housing coupled to the sander body, the lower housing being arranged and configured to swivel relative to the sander body; and

a dust collector coupled to the lower housing, wherein a user can adjust a rotational orientation of the dust collector relative to the sander body by manually swiveling the lower housing relative to the sander body.

2. The sander of claim **1**, wherein the lower housing defines at least a portion of a dust exhaust channel and the dust collector is coupled to the dust exhaust channel.

3. The sander of claim **1**, wherein the lower housing has an interlocking complementary shape with respect to the sander body so as to be coupled to the sander body

(i) with a frictional fit in a manner enabling the lower housing to be selectively swiveled rotationally by sliding the sander body against the frictional fit relative to the lower housing to a position desired by the user, and

(ii) to prevent the lower housing and the sander body from being removably separated from each other when the user is selectively swiveling the lower housing about the sander body.

4. The sander of claim of **1**, wherein the lower housing can be swiveled without the use of a tool.

5. The sander of claim **2**, wherein the dust exhaust channel extends outward from the lower housing.

6. The sander of claim **1**, further comprising a counterweight coupled to the motor and housed within the lower housing, the counterweight including a plurality of fan blades adapted for use in dust collection.

7. The sander of claim **4**, wherein the lower housing is retained in the desired rotational position relative to the sander body by friction.

8. The sander of claim **1**, wherein the lower housing includes two half pieces that when interconnected interlock with the sander body such that the lower housing and the sander body are prevented from being removably separated from each other when the user is selectively swiveling the lower housing about the sander body.

9. The sander of claim **1**, wherein the lower housing is made of a plastic material.

10. A palm grip random orbit sander comprising:

a sander body, a pad for supporting sandpaper, a motor housed by the sander body, and a random orbit coupler system which couples the motor to the pad to impart a random orbit sanding motion to the pad, the sander body being sized for a palm grip on a top of the sander body; and

a lower housing coupled to the sander body, the lower housing being arranged and configured to swivel relative to the sander body, and the lower housing defining a dust collection channel that extends outward from a main body of the lower housing, wherein a user can adjust a rotational orientation of the dust collection channel relative to the sander body by manually swiveling the lower housing relative to the sander body.

11. The sander of claim **10**, further comprising a passive dust collector adapted to be secured to the dust collection channel.

12. The sander of claim **10**, wherein the lower housing has an interlocking complementary shape with respect to the sander body so as to be coupled to the sander body

(i) with a frictional fit in a manner enabling the lower housing to be selectively swiveled rotationally by sliding the sander body against the frictional fit relative to the lower housing to a position desired by the user, and

(ii) to prevent the lower housing and the sander body from being removably separated from each other when the user is selectively swiveling the lower housing about the sander body.

13. The sander of claim **10**, wherein the lower housing can be swiveled without the use of a tool.

14. The sander of claim **10**, further comprising a counterweight coupled to the motor and housed within the lower housing, the counterweight including a plurality of fan blades adapted for use in dust collection.

15. The sander of claim **13**, wherein the lower housing is retained in the desired rotational position relative to the sander body by friction.

16. The sander of claim **10**, wherein the lower housing includes two half pieces that when interconnected interlock with the sander body so as to prevent the lower housing and the sander body from being removably separated from each other when the user is selectively swiveling the lower housing about the sander body.

17. The sander of claim **10**, wherein the lower housing is made of a plastic material.

18. A palm grip random orbit sander comprising:

an upper housing including a top portion sized and shaped for a palm grip;

a motor housed by the upper housing, the motor including a motor shaft;

a counterweight connected to the motor shaft, the counterweight including a plurality of fan blades for use in dust collection, the counterweight also including an eccentrically located protrusion;

a bearing having an inner race and an outer race, the inner race being mounted on the protrusion of the counterweight;

a pad holder mounted on the outer race of the bearing;

a pad secured to the pad holder, the pad defining a plurality of vacuum holes for use in dust collection; and

a lower housing coupled to the upper housing, the lower housing being arranged and configured to swivel relative to the upper housing, the lower housing at least partially housing the counterweight, and the lower housing defining a dust collection port adapted for connection to a dust collector, wherein a user can adjust a rotational orientation of the dust collection port relative to the upper housing by manually swiveling the lower housing relative to the upper housing without requiring a tool to loosen a connection between the lower housing and the upper housing.

19. The sander of claim **18**, further comprising a passive dust collector adapted to be connected to the dust collection port.

20. The sander of claim **18**, wherein the lower housing has an interlocking complementary shape with respect to the upper housing so as to be coupled to the upper housing

(i) with a frictional fit in a manner enabling the lower housing to be selectively swiveled rotationally by sliding the upper housing against the frictional fit relative to the lower housing to a position desired by the user, and

(ii) to prevent the lower housing and the upper housing from being removably separated from each other when the user is selectively swiveling the lower housing about the upper housing.

21. The sander of claim **18**, wherein the lower housing includes two half pieces adapted to be interconnected with one another, wherein when the two half pieces are interconnected, the half pieces are adapted to interlock with the upper housing to prevent the lower housing and the upper housing from being removably separated from each other when the user is selectively swiveling the lower housing about the upper housing.

22. The sander of claim **18**, wherein the upper housing includes a head portion and a neck portion, the neck portion being sized and shaped to receive the user's fingers when the user's palm engages the head portion.

23. A random orbit sander comprising:

a sander body, a pad for supporting sandpaper, a motor housed by the sander body, and a random orbit coupler system which couples the motor to the pad to impart a random orbit sanding motion to the pad; and

a lower housing arranged and configured to swivel relative to the sander body, the lower housing defining a dust collection port adapted for connection to a dust collector, wherein a user can adjust a rotational orientation of the dust collection port relative to the sander body by manually swiveling the lower housing relative to the sander body without requiring a tool.

24. The sander of claim **23**, further comprising a passive dust collector adapted to be connected to the dust collection port.

25. The sander of claim **23**, wherein the lower housing has an interlocking complementary shape with respect to the sander body so as to be coupled to the sander body

(i) with a frictional fit in a manner enabling the lower housing to be selectively swiveled rotationally by sliding the sander body against the frictional fit relative to the lower housing to a position desired by the user, and

(ii) to prevent the lower housing and the sander body from being removably separated from each other when the user is selectively swiveling the lower housing about the sander body.

26. The sander of claim **23**, wherein the lower housing includes at least two separate pieces that when interconnected are adapted to interlock with the sander body to prevent the lower housing from being removed from the sander body.

27. The sander of claim **23**, wherein the lower housing is made of a plastic material.

28. The sander of claim **26**, wherein the sander body defines one or more slots extending at least partially about a circumference of the sander body, and the lower housing includes one or more portions that project within the slots to provide an interlocked connection between the lower housing and the sander body.

29. The sander of claim **23**, further comprising a counterweight coupled to the motor and housed within the lower housing, the counterweight including a plurality of fan blades adapted for use in dust collection.

30. A palm grip random orbit sander comprising:

an upper housing, a pad for supporting sandpaper, a motor at least partially housed by the upper housing, and a random orbit coupler system which couples the motor to the pad to impart a random orbit sanding motion to the pad, the upper housing being sized and shaped for a palm grip on a top of the upper housing; and

a lower housing coupled to the upper housing, the lower housing defining a dust collection port adapted for connection to a dust collector, and the lower housing including at least two separate pieces adapted to be interconnected with one another, the at least two separate pieces being arranged and configured to interlock with the upper housing to prevent the lower housing and the upper housing from being removably separated from each other.

31. The sander of claims **30**, further comprising a passive dust collector adapted to be secured to the dust collection channel.

32. The sander of claim **30**, wherein the lower housing can be manually swiveled with respect to the upper housing.

33. The sander of claim **30**, further comprising a counterweight coupled to the motor and housed within the lower housing, the counterweight including a plurality of fan blades adapted for use in dust collection.

34. The sander of claim **33**, wherein the counterweight includes an eccentrically located protrusion, and the sander further includes a bearing having an inner race and an outer race, the inner race being mounted on the protrusion of the counterweight, and the outer race being connected to a pad holder adapted for holding the pad of the sander.

35. The sander of claim **30**, wherein the at least two pieces of the lower housing include two mating half pieces.

36. The sander of claim **30**, wherein the lower housing is made of a plastic material.

37. The sander of claim **30**, wherein the upper housing includes a head portion and a neck portion, the neck portion being sized and shaped to receive a user's when the user's palm engages the head portion.

38. The sander of claim **30**, wherein the upper housing defines one or more slots extending at least partially about a circumference of the upper housing, and the lower housing includes one or more portions that project within the slots to provide an interlocked connection between the lower housing and the upper housing.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,934,985
DATED : August 10, 1999
INVENTOR(S) : Clowers et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 8,
Line 27, "claims" should read -- claim --
Line 48, after first occurrence of "user's" insert -- fingers --

Signed and Sealed this

Twenty-first Day of May, 2002

Attest:

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

Attesting Officer